**Introduction:** The Arecibo Observatory Space Academy (AOSA) is an intense semester-long pre-college research program with ten on site contact days, for highly qualified high school students in Puerto Rico. The program seeks to increase public engagement efforts of the Arecibo Observatory. On Saturdays, selected students participate in this semester-long research program targeted to aid in their individual academic and social development. The students are welcomed as candidates or "cadets-to-be" the first weeks. They become cadets while experiencing designing, proposing, and carrying out research projects related to the exploration of space focusing in STEM fields such as Physics, Astronomy, Planetary Science, Geology, and Engineering.

AOSA’s mission is to prepare students for careers in Science, Technology, Engineering, and Mathematics (STEM) related fields via a student-centric immersive research experience. The program seeks to allow students to receive an independent and collaborative research experience on topics related to space and aid in their individual academic and social development. Our objectives are to: (1) Supplement the student’s STEM education via inquiry-based learning and indirect teaching methods. (2) Immerse students in an ESL (English as a Second Language) environment, further developing their verbal and written presentation skills [1]. (3) To foster in every student an interest in science by harnessing their natural curiosity and knowledge in order to further develop their critical thinking and investigation skills.

**Motivation:** Hispanics and Latinos are the largest underrepresented group with a measured interest in STEM fields. Studies show that Hispanic and Latino students are equally as interested in entering a STEM major in college as their White counterparts, and yet they are less likely to graduate with a degree in a STEM field [2]. There is indisputably a gap to be filled, one that occurs past the interest in STEM and before the student decides their career path. At the professional stage, it gets even more noticeable, despite the fact Latinos and Hispanics compose nearly 20% of the U.S. population, they only account for 3% of the STEM doctoral degrees and 3% of Physics faculty in the United States.

AOSA seeks to meet these challenges by harnessing the student’s natural curiosity during high school in order to prepare them academically for the rigors of collegiate STEM studies. The program also builds a strong mentor network. Arecibo Observatory staff, along with AOSA staff become part of the student’s network. AOSA also builds a strong sense of a cohort for the incoming class so they can rely on each other in the future.

**Pedagogy:** The AOSA program applies multiple instructional methods for students to expand their skills and knowledge [3]. Being part of a scientific environment helps to promote student ingenuity. During the meetings held on Saturdays, the cadets are exposed to the following teaching methodologies:

**Explaining or lecturing:** the process of teaching by oral communication, usually with the aid of visual enhancements, such as PowerPoint, videos, and white board.

**Demonstrations:** teaching process that uses examples and experiments as the main instructional technique. Demonstrations are a preferred technique, as it has been shown to reinforce memory retention by linking scientific facts with real-world applications.

**Collaborative Teaching:** allow students to become engaged in the learning process by sharing ideas and debating opinions. Inquiry based learning assists students in establishing a personal connection among their teams, bringing together their topic, ability to work as a team, presentation and leadership skills.

**Teaching:** using role switching, students assume the role of the instructor and teach their topics to their peers. Students exposed to this teaching methodology tend to increase their self-confidence, leadership, and ESL skills. The students participating in the program are required to have an interest to explore the world around them. This is a very demanding program that requires a great amount of dedication and time management skill development.

**Figure 1:** Map and Graphs of AOSA Statistics. AOSA has recruited students for nearly 75% of Puerto Rico. The program has on average recruited and retained a well-balanced class in terms of gender and grade. All college-aged alumni have entered college and are majoring in a STEM field.
Selection and Evaluation: Hispanic students are among the most underrepresented groups in science and engineering, so this program is especially important to reach the Puerto Rican community. Students interested in participating in the program go through an application, interview and trial period before offering admission as a cadet. Each individual is evaluated with program compatibility based on peer interaction, preparation, participation, contribution to class, group dynamics, attitude, challenges and inquiry[4]. This helps to ensure that specialized attention can be given to students who demonstrate a dedication and desire to learn.

Hands-On Research Activities: During the semester, AOSA students are responsible for designing, proposing, and implementing a research project. Project topics and designs are very flexible to accommodate anything related to space exploration and humans in space. Each Semester cadets get the opportunity to explore their topic of choice while practicing many of the foundations of scientific research focusing on four fields: Physics/Astronomy, Biology, Geology, and Engineering. For many students, this is a new experience, and they find that real science is nothing like cinema magic. Students are encouraged to find innovative ways to find answers, and to use all available resources in their research.

Deciding how to proceed in the face of set-backs and unexpected problems is central to the learning experience. At the end of the semester students present their research to the program mentors, peers, and scientific staff. In Puerto Rico, education is in Spanish, although English is part of the curriculum. To continue in STEM fields, students must be proficient in English, so cadets are strongly encouraged to work on both writing and speaking skills. Students are also challenged to create a space settlement design and to submit to the National Space Society-NASA Ames Space Settlement Design Contest during the Fall Semester [5]. With the goal of creating a habitable colony in free space and a zero-waste environment, cadets expand their zero waste plans to their schools and communities. Outstanding students travel in the spring semester to present their design at the International Space Development Conference (ISDC).

Science Communication: During the semester, students are tasked to help organize public engagement events at the Arecibo Observatory Science and Visitor Center. They must also create hands-on events for the public. During this process, students learn how to communicate science effectively, and in the process of teaching, themselves learn more in-depth the material. Students have organized World Space Week [6] Yuri’s Night [7], OSIRIS-REx launch event, and celebration of Hispanic Heritage Month. Students have also worked with the NASA FameLab event and participated in a mock event where they learned and practiced science communication strategies.

Conclusions: Puerto Rico offers very little opportunity for pre-college students to gain experience in learning through active participation because few local schools have any resources at their disposal. We aspire to liberate our students from the box of standardized education and testing that high school students often experience. The academy provides a place for students from around Puerto Rico with common interests in space and other technical fields to collaborate and meet their future peers. We ensure that the students are given the chance to interact and make lasting connections with each other, mentors, and people in their fields of interest, whom they might not have met otherwise.

AOSA has demonstrated that it can recruit and retain a well-balanced class of students in terms of gender, age, and school type. More importantly, the program has demonstrated that it can prepare students for collegiate life in a STEM field. All college-aged AOSA alumni have gone on to major in a STEM field. More importantly, the program has facilitated retention of this cohort, which will be graduating this May 2017. The AOSA program, through its student prepartation and mentor network, has defeated the obstacle that Latinos and Hispanics face in college. The program is effectively producing STEM graduates.

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